

Pillar Axiom Path Manager 3.4



Installation Guide
and Release
Notes

for Windows



PILLAR AXIOM

Part Number: E39451-01

APM 3.4

2013 May

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Table of Contents

Preface

Chapter 1 Introduction to APM

About APM for Windows.	12
Supported Windows Platforms.	13
Supported Windows Server 2012 Editions.	13
Supported Windows Server 2008 R2 Editions.	14
Supported Windows Server 2008 Editions.	14
Supported Windows Server 2003 R2 Editions.	14
Supported Windows Server 2003 Editions.	15
About the APM Software.	16
APM Architecture.	17
About the APM Control Path.	19
About the APM Data Path.	20
APM for Windows Features.	21
About Configuration at the Host.	23
About Boot from SAN.	25
About APM and Hyper-V.	26
About APM and Clustering.	27
Operating Limits.	28
About FC SAN Component Support.	29
Supported FC HBAs.	29
Supported FC HBA Settings.	30
Supported FC Switches.	31
About Fibre Channel Over Ethernet Support.	33
Supported Fibre Channel Over Ethernet CNA Requirements.	33
Supported Fibre Channel Over Ethernet Switches.	34
About Oracle Fabric Interconnect (Xsigo Director) Support.	35
Supported Oracle Fabric Interconnect (Xsigo) Drivers.	35

About iSCSI Software and Hardware Support.	36
Supported iSCSI Software.	36
Supported iSCSI HBAs.	37
Supported iSCSI-to-FC Routers.	37
Supported iSCSI Switches.	38
Chapter 2 Install APM	
About APM Software Installation.	39
APM Preinstallation Requirements.	40
Management Network Requirements.	40
HBA Driver and Software Requirements.	41
Microsoft Service Pack and Hotfix Requirements.	41
Configure a FC SAN.	42
Configure the iSCSI-to-FC Router.	43
Configure an iSCSI SAN.	44
Configure iSCSI Connections for SAN.	44
Download and Install the APM Software.	46
Download the APM Software.	46
Install the APM Software.	47
Configure SAN Host Access to the Pillar Axiom LUNs.	49
Boot-from-SAN Tips.	52
About Boot LUNs.	52
About Boot Device Paths.	52
About Boot Device Failover.	53
Clone a Boot LUN.	53
About Load Balancing Configurations.	54
About Path Selection.	55
About Updating the APM Software.	57
Update the APM Software on Windows Server 2003.	58
Remove the APM Software (Optional).	59
Chapter 3 APM Release Notes	
New in This Release.	61
Known APM Issues.	62
Known Pillar Axiom Issues.	63
Known Operating System Issues.	66
[36166] APM Installation Hangs.	66
[13746944] Multiple iSCSI Initiator Names.	66
[13750786] Warmstart Suspends I/O to LUNs.	66

[13754533] Hyper-V Delays Switching to Alternate iSCSI Path.	67
[13755165] Added iSCSI Paths Not Detected.	67
[15906824] Failed iSCSI Paths Not Detected.	67
[16022428 16050171] QLogic iSCSI Driver Crashes.	67
[16049073] Qlogic iSCSI SAN HBA.	68
Microsoft Windows Knowledge Base MPIO Articles.	68
Resolved APM Issues.	72
Additional Notes.	73
[48764, 48811] Faulty SAN Component.	73
Index.	74



List of Figures

Figure 1 APM interaction with a Pillar Axiom system. 18

Figure 2 Example host ports before APM installation. 49

Figure 3 Example host ports after APM installation. 49



List of Tables

Table 1 Typography to mark certain content. 9

Table 2 Oracle resources. 10

Table 3 Line and color key. 17

Table 4 APM 3.4 for Windows features. 21

Table 5 APM operating limits. 28

Table 6 Recommended QLogic HBA settings. 31

Table 7 Recommended Emulex HBA settings. 31

Table 8 Supported FCoE CNA settings. 33

Table 9 Known APM issues. 62

Table 10 Known Pillar Axiom issues. 63

Table 11 Microsoft Windows MPIO knowledge base articles. 68

Table 12 Resolved APM issues. 72

Preface

Before You Read This Document

Being familiar with certain other Pillar Axiom technical documentation helps you succeed in the use of this guide.

Familiarize yourself with the following related documentation:

- *Pillar Axiom Customer Release Notes*
- *Pillar Axiom Administrator's Guide*
- *Pillar Axiom CLI Reference Guide*
- *Pillar Axiom Support and Interoperability Guide*

Typographical Conventions

Table 1 Typography to mark certain content

Convention	Meaning
<i>italics</i>	Within normal text, words in italics indicate one of the following: <ul style="list-style-type: none">• A reference to a book title• New terms and emphasized words• Command variables
monospace	Indicates one of the following, depending on the context: <ul style="list-style-type: none">• The name of a file or the path to the file• <i>Output</i> displayed by the system on the command line
monospace (bold)	<i>Input</i> provided by an administrator on the command line.

Table 1 Typography to mark certain content (continued)

Convention	Meaning
>	Indicates a menu item or a navigation path in a GUI. For example, “Click Storage > Clone LUNs ” means to click the Clone LUNs link on the Storage page in the GUI.
...	Used within an expression of a navigation path or within a cascading menu structure. The ellipsis indicates that one or more steps have been omitted from the path or menu structure. For example, in the Groups > Volume Groups > Actions > ... > Data Protection > Create menu structure, the ... implies that one or more menu items have been omitted.

Oracle Contacts

Table 2 Oracle resources

For help with...	Contact...
Support	http://www.oracle.com/support (www.oracle.com/support)
Training	https://education.oracle.com (https://education.oracle.com)
Documentation	<ul style="list-style-type: none"> • Oracle Technology Network Documentation: (http://docs.oracle.com) • From the Pillar Axiom Storage Services Manager (GUI): Support > Documentation • From Pillar Axiom HTTP access: (http://system-name-ip/documentation.php where <i>system-name-ip</i> is the name or the public IP address of your system.)
Documentation feedback	http://www.oracle.com/goto/docfeedback

Table 2 Oracle resources (continued)

For help with...	Contact...
	http://www.oracle.com/goto/docfeedback
Contact Oracle	http://www.oracle.com/us/corporate/contact/index.html (http://www.oracle.com/us/corporate/contact/index.html)

CHAPTER 1

Introduction to APM

About APM for Windows

The information in this document is for system administrators who want to use the Pillar Axiom Path Manager (APM) software on a SAN host running the Windows Server operating systems on 32-bit, x64, and Itanium-based systems.

This document describes how to install and configure the APM for Windows software.

This APM release requires release 4.5 or higher of the Pillar Axiom software.

Note: If you are updating your Pillar Axiom software, complete that update before installing the APM software on the SAN host.

This release supports both Fibre Channel and iSCSI Slammers ports. You can connect your host to Fibre Channel or iSCSI ports on Slammers, and you can connect your host through iSCSI-to-FC routers to Fibre Channel ports on Slammers.

Related tasks

- [Download the APM Software](#)
- [Install the APM Software](#)
- [Configure SAN Host Access to the Pillar Axiom LUNs](#)
- [About Updating the APM Software](#)
- [Remove the APM Software \(Optional\)](#)

Supported Windows Platforms

Pillar Axiom Path Manager (APM) 3.4 for Windows supports the following Windows editions on 32-bit, x64, and Itanium processor platforms.

Note: Some of the editions of Windows Server 2008 R2 and Windows Server 2008 listed here include the Hyper-V option, and others do not. APM 3.4 supports the editions that include Hyper-V, regardless of whether Hyper-V is enabled and in use.

For more information on the different editions of Windows Server, refer to:

- [Microsoft's Windows Server 2012 Web site](http://www.microsoft.com/en-us/server-cloud/windows-server/)
(<http://www.microsoft.com/en-us/server-cloud/windows-server/>)
- [Microsoft's Windows Server 2008 Web site](http://technet.microsoft.com/en-us/windowsserver/bb3105588)
(<http://technet.microsoft.com/en-us/windowsserver/bb3105588>)
- [Microsoft's Windows Server 2003 Web site](http://technet.microsoft.com/en-us/windowsserver/bb512919.aspx)
(<http://technet.microsoft.com/en-us/windowsserver/bb512919.aspx>)

For additional information regarding software use and lists of current and resolved product issues, refer to the Release Notes.

Related concepts

- [Microsoft Service Pack and Hotfix Requirements](#)

Related references

- [Supported Windows Server 2012 Editions](#)
- [Supported Windows Server 2008 R2 Editions](#)
- [Supported Windows Server 2008 Editions](#)
- [Supported Windows Server 2003 R2 Editions](#)
- [Supported Windows Server 2003 Editions](#)

Supported Windows Server 2012 Editions

- Windows Server 2012 Foundation
- Windows Server 2012 Essentials
- Windows Server 2012 Standard
- Windows Server 2012 Datacenter

Supported Windows Server 2008 R2 Editions

- Windows Server 2008 R2 Standard
- Windows Server 2008 R2 Enterprise
- Windows Server 2008 R2 Datacenter
- Windows Web Server 2008 R2
- Windows Server 2008 R2 for Itanium-Based Systems

Supported Windows Server 2008 Editions

- Windows Server 2008 Standard
- Windows Server 2008 Enterprise
- Windows Server 2008 Datacenter
- Windows Server 2008 Standard without Hyper-V
- Windows Server 2008 Enterprise without Hyper-V
- Windows Server 2008 Datacenter without Hyper-V
- Windows Server 2008 for Itanium-Based Systems

Note: APM 3.4 supports Windows Server 2008 with or without SP2.

Supported Windows Server 2003 R2 Editions

APM 3.4 requires SP2 with Windows Server 2003 R2.

- Windows Server 2003 R2 Standard Edition with SP2
- Windows Server 2003 R2 Enterprise Edition with SP2
- Windows Server 2003 R2 Standard x64 Edition with SP2
- Windows Server 2003 R2 Enterprise x64 Edition with SP2

- Windows Server 2003 R2 Enterprise Edition with SP2 for Itanium-based Systems

Note: Microsoft Storport Hotfix 932755 must be installed *after* SP2.

Supported Windows Server 2003 Editions

APM 3.4 requires SP2 with Windows Server 2003.

- Windows Server 2003 Standard Edition with SP2
- Windows Server 2003 Enterprise Edition with SP2
- Windows Server 2003 Web Edition with SP2
- Windows Server 2003 Standard x64 Edition with SP2
- Windows Server 2003 Enterprise x64 Edition with SP2
- Windows Server 2003 Enterprise Edition with SP2 for Itanium-based Systems

Note: Microsoft Storport Hotfix 932755 must be installed *after* SP2.

About the APM Software

The Pillar Axiom Path Manager (APM) software runs on the host system. Usually, multiple paths are presented as multiple drives. With this software, every configured multi-pathed Pillar Axiom LUN is presented as a single drive to the operating system.

The APM 3.4 for Windows software integrates with the Microsoft Windows Multipath I/O (MPIO) component. APM consists of a configuration service and an MPIO Device Specific Module (DSM) for the Pillar Axiom system. This combination, along with the Microsoft MPIO component, allows Windows to detect and configure Pillar Axiom storage devices, and to manage the I/O paths to those devices.

On Windows Server 2003 and Windows Server 2003 R2, APM 3.4 installs version 1.23 of the Microsoft MPIO component. On Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012, APM uses the version of MPIO that has been installed as part of Windows.

Note: One host can access a maximum of 255 LUNs on each Pillar Axiom system, up to a maximum of eight Pillar Axiom systems. The LUNs should be numbered from 0 to 254 because Windows does not recognize LUN number 255.

APM Architecture

Pillar Axiom Path Manager (APM) manages multipathing and communicates with the Pillar Axiom systems on a control path, which is separate from the data path. LUN access is managed along the data path.

The following figure illustrates how the APM software installed on a SAN host interacts with a Pillar Axiom system. Refer to the table below to determine the significance of the lines and colors in the figure.

Table 3 Line and color key







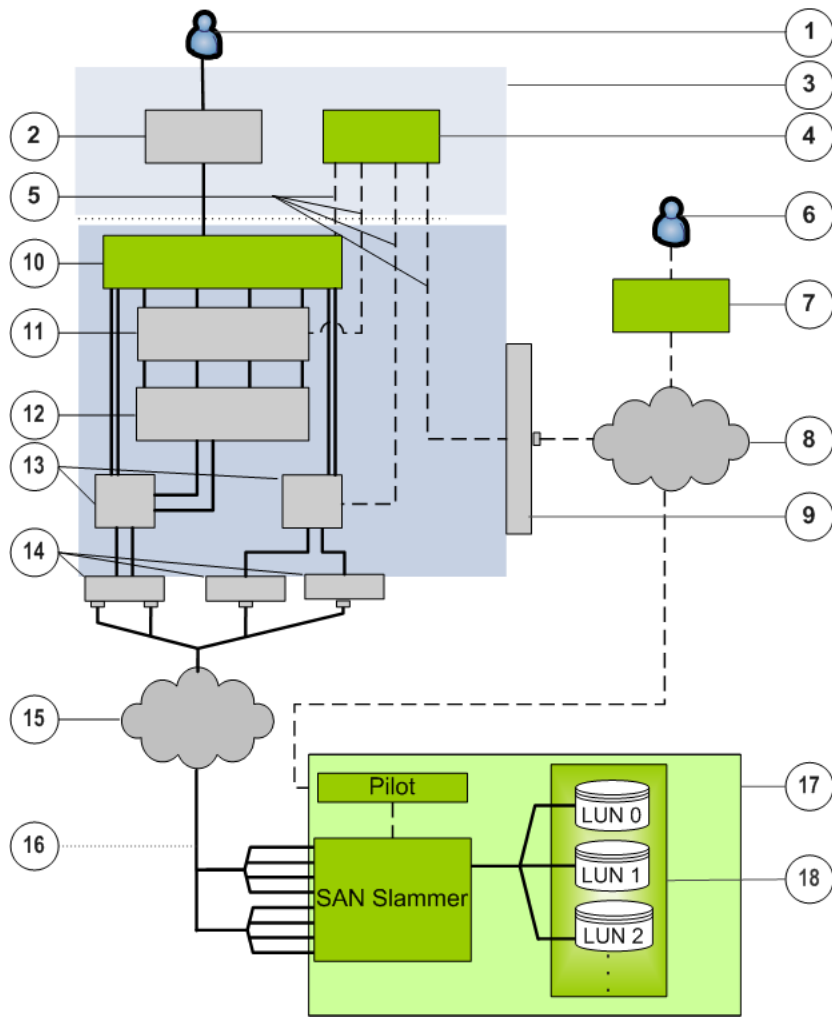
Graphic element	Description
	Data path
	Control path
	Pillar Axiom hardware and software
	Non-Pillar Axiom hardware and software
	SAN host system space
	SAN host user space

Figure 1 APM interaction with a Pillar Axiom system



Legend		
1 User		10 APM Device-Specific Module (DSM)
2 User application		11 iSCSI software initiator (iSCSI only)
3 SAN host		12 TCP/IP driver (iSCSI only)
4 APM service		13 HBA driver (FC or iSCSI) or NIC driver (iSCSI)
5 Control path (all dashed lines)		14 HBA (FC or iSCSI) or NIC (iSCSI)
6 Pillar Axiom administrator		15 SCSI over FC or iSCSI over IP
7 Pillar Axiom CLI or GUI		16 Data path (all solid lines)
8 Encrypted XML over TCP/IP		17 Pillar Axiom system
9 Network card		18 Brick storage pool

About the APM Control Path

The Pillar Axiom Path Manager (APM) control path provides a path separate from the data path to manage multipathing and communication.

The Pillar Axiom Path Manager (APM) service assists with driver configuration and uses the control path to:

- Get information from the Pilot management controller
- Get FC and iSCSI port information from the HBA and converged network adapter (CNA) drivers and from the iSCSI initiator
- Configure the APM Device-Specific Module (DSM)
- Send information such as host attributes and statistics to the Pilot management controller and, on request, collect logs from the host

The APM service sends a description of the host to the Pilot on each connected Pillar Axiom system. In the Pillar Axiom Storage Services Manager, this description creates a definition for the host that includes any FC ports in the host and, if iSCSI is configured, the name of the iSCSI initiator.

The Pillar Axiom GUI and CLI list the World Wide Names (WWNs) of the FC ports in the host and the IP addresses that are used to make iSCSI connections to the Pillar Axiom system.

If you use iSCSI on the host to connect to a FC Slammer storage controller through an iSCSI-to-FC router, these connections are described as FC connections. Within APM, the connections appear to originate from the FC ports on the switch that are assigned to the host iSCSI initiator. The WWNs of these ports are displayed as FC HBA ports on the host. The HBA model associated with these ports is reported as iSCSI-FC router.

You can configure the software for static or round-robin load balancing through the Pillar Axiom Storage Services Manager.

Note: A control path connection to the Pilots on connected Pillar Axiom systems is recommended but optional. Functionality available through the control path will not be available if there is no control path connection.

About the APM Data Path

The Pillar Axiom Path Manager (APM) Device Specific Module (DSM), an MPIO module for the Pillar Axiom system, manages I/O to storage devices over the data path.

The DSM is responsible for the following:

- Supports failover across redundant paths
- Controls and manages all data paths to Pillar Axiom LUNs
- Groups multiple data paths to a Pillar Axiom LUN and presents this group to the host operating system as a single LUN or drive
- Determines which path to use to implement load balancing
- Identifies and uses optimized data paths when possible
- Handles data path failover and failback
- Manages data path errors
- Handles reserve and release commands for clustering

See the architecture diagram for an illustration of how data flows from the host to the Pillar Axiom system.

A path that provides the best performance is referred to as an *optimized path*. It is the preferred path for data transfer.

APM for Windows Features

Pillar Axiom Path Manager (APM) is defined as:

Optional software installed on a storage area network (SAN) host to manage multiple paths to the Pillar Axiom system.

APM performs the following primary functions:

- Routes I/O to Pillar Axiom LUNs using only the best available data paths.
- Shares traffic among the available paths and ensures that access to the LUNs is not interrupted if some paths fail.
- Automatically configures the host into the Pillar Axiom Storage Services Manager and updates the configuration if the host information changes.

The function described in the last bullet enables the Pillar Axiom Storage Services Manager to report information about APM running on the host, such as the number of working paths, and, in some environments, to configure features such as load balancing. This function is only available if the host has a control path connection to the Pillar Axiom Pilot.

Each APM release provides different features, and the features provided for each platform may vary. Refer to the following table for descriptions of the specific features implemented in this release.

Table 4 APM 3.4 for Windows features

Feature	Benefit
Automatic data path failover	Automatically switches to the best available path after a path failure or fail back.
Automatic recognition of SAN hosts by the Pillar Axiom Storage Services Manager	Sends a description of the host to each Pilot management controller on connected Pillar Axiom systems, allowing the Pillar Axiom Storage Services Manager and CLI tools to create a definition for the host. This definition includes such information as the WWNs for each of the host's FC ports, and the version of APM running on the host. Note: This feature is only available if the host has a control path connection to the Pillar Axiom Pilot.
Call-Home log collection	When a Pillar Axiom administrator uses the Pillar Axiom Storage Services Manager to collect system information (refer to the <i>Pillar Axiom Administrator's Guide</i> for details),

Table 4 APM 3.4 for Windows features (continued)

Feature	Benefit
	<p>the Pillar Axiom system sends a request to each connected APM host. The APM hosts collect useful diagnostic information and send the information to the Pillar Axiom system, where it is bundled with any other requested information. The Pillar Axiom system can then transmit this information to create a Service Request with Oracle Customer Support.</p> <p>The information collected from each APM host includes:</p> <ul style="list-style-type: none"> • Logs from the APM components • Configuration and status information from the operating system • System and error logs from the operating system <p>Note: No customer data is transmitted.</p> <p>Note: This feature is only available if the host has a control path connection to the Pillar Axiom Pilot.</p>
Support for upgrades	Upgrades from earlier versions of APM are supported.
LUN access	Access to Pillar Axiom LUNs using both iSCSI and FC is supported.
FC HBAs	<p>All FC HBAs that meet the following HBA driver requirements are supported:</p> <ul style="list-style-type: none"> • Storport miniport driver • Digitally signed by the Microsoft Windows Hardware Compatibility Publisher; these drivers may be referred to as "WHQL signed" or "WHQL certified" or "Windows certified" • Dated after January 1, 2008 <p>FC HBAs with speeds ranging between 2 to 16 Gb/s are supported.</p>
iSCSI hardware and software	QLogic iSCSI HBAs and the Microsoft iSCSI Initiator are supported.
Configuration at the host	Ability to configure APM at the host in the absence of a control path connection to the Pillar Axiom system is supported.

Table 4 APM 3.4 for Windows features (continued)

Feature	Benefit
Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs)	FCoE CNAs on the host are supported.
Oracle Fabric Interconnect (formerly Xsigo Director)	Oracle Fabric Interconnect and associated Oracle Virtual Networking host software provide Ethernet and FC emulation over InfiniBand.
Boot from SAN	Boot from SAN is supported for both iSCSI and FC.
Clustering	Both FC and iSCSI clusters are supported.
Load balancing	I/O can be balanced across the best available paths. Both static and round-robin load balancing are supported. Round-robin is the default value.

Related concepts

- [About Boot from SAN](#)
- [About Configuration at the Host](#)
- [About Oracle Fabric Interconnect \(Xsigo Director\) Support](#)
- [About APM and Hyper-V](#)
- [About APM and Clustering](#)

About Configuration at the Host

Configuration at the host without a control path connection is supported through use of standard Microsoft Multipath I/O (MPIO) Windows Management Instrumentation (WMI) interfaces and persistence of the most recent load balancing setting at the host.

APM works with Microsoft MPIO to implement the MPIO WMI Classes. Refer to [MPIO WMI Classes](http://msdn.microsoft.com/en-us/library/ff562468(VS.85).aspx) (http://msdn.microsoft.com/en-us/library/ff562468(VS.85).aspx) for details. APM does not use or support all aspects of these classes. For example, APM implements two load balancing algorithms, while the WMI classes define more.

Windows Server 2008 R2 and Windows Server 2012 use these classes to implement extensions to various management applets. For example, the Device

Properties applet associated with Pillar Axiom LUNs has an MPIO tab that displays information from the WMI classes and allows modification of some fields. APM allows only certain fields to be modified. The optimization state of paths, for example, is controlled entirely by the Pillar Axiom system. Attempts to modify fields which APM does not support will not fail, but the setting will not be changed.

The APM distribution includes a simple VBscript script (`Scripts\lbset.vbs` in the installation directory) as an example of a way to access the WMI classes from scripts. To use this script, open a command prompt, change to the Scripts directory, and run `cscript lbset.vbs`. This script lists the current load balancing setting for all Pillar Axiom LUNs accessible by the host, and then updates their settings to round-robin.

You may find this particular functionality useful, but the main purpose of this script is to illustrate how to access the WMI functionality from a script. You may copy and modify this script to implement whatever functionality you choose.

Note: The load balancing setting for LUNs is normally configured at the Pillar Axiom system using the Pillar Axiom Storage Services Manager GUI or CLI. When a LUN is first discovered, the default setting is round-robin.

When APM is running in its recommended configuration, with a control path connection to the Pilot, it may update the load balancing configuration from time to time to that stored at the Pillar Axiom system. When load balancing is configured using WMI, only the current setting at the host is changed.

If APM has a control path connection to the Pillar Axiom system, the setting may subsequently be updated at any time to match that configured at the Pillar Axiom system. Therefore, the ability to configure the load balancing configuration through WMI is mainly of use if you choose to use APM without a control path connection to the Pillar Axiom system.

APM remembers the latest load balancing configuration at the host. When the host is rebooted, LUNs will come online using the load balancing configuration most recently set through one of the following means:

- From the settings provided by WMI
- From the APM configuration at the Pillar Axiom system
- From the default setting, which is round-robin, when the LUN was first discovered

Note: When running APM without a control path connection, the following occur:

- The host name, along with all associated host FC port WWNs and iSCSI initiator names, must be entered at the **SAN > Storage > Hosts** page in the Pillar Axiom GUI
- Load balancing configuration from the Pillar Axiom GUI or CLI is ignored
- APM logs created on the host cannot be collected nor managed by the Axiom Storage Services Manager

Related concepts

- [About Path Selection](#)
- [About Load Balancing Configurations](#)

Related tasks

- [Configure SAN Host Access to the Pillar Axiom LUNs](#)

About Boot from SAN

The Pillar Axiom Path Manager (APM) software supports booting the host using a LUN on a Pillar Axiom system accessed over iSCSI or FC as the system drive.

You can use the LUN as a system drive, but we recommend that you use a storage device directly attached to the host as the paging file.

To use this feature, your system and configuration must support booting from a SAN-attached drive. Verify with your system and CNA, HBA or NIC manufacturers that boot from SAN is supported.

Setting up a SAN with network boot technology has many hardware dependencies and deployment scenarios that are beyond the scope of this document. Configuration of boot-from-SAN depends on your system, so you will need to refer to your system and hardware vendor documentation.

Note: Booting from SAN with the Extensible Firmware Interface (EFI) on Itanium-based systems has not been tested in this release. If you want to set up an Itanium-based system for boot from SAN with APM, first contact your host hardware vendor, and then contact the Oracle Customer Support.

Boot-from-iSCSI-SAN can use any of three mechanisms:

- iSCSI HBAs
- iSCSI-boot-enabled Ethernet NICs (for example, using Intel PRO/1000 PT Server Adapters with iSCSI boot firmware)

- Preboot Execution Environment (PXE) boot of secondary bootstrap (for example, using Vision Solutions' Double-Take Flex)

For information on how to set up a Windows system to boot from a SAN-attached drive, refer to the following Microsoft articles:

- [Support for booting from a Storage Area Network \(SAN\)](http://support.microsoft.com/kb/305547) (<http://support.microsoft.com/kb/305547>)
- [Windows Boot from Fibre Channel SAN](http://www.microsoft.com/downloads/details.aspx?FamilyID=f4095fae-553d-4700-aafa-1cce38b5618f) (<http://www.microsoft.com/downloads/details.aspx?FamilyID=f4095fae-553d-4700-aafa-1cce38b5618f>)
- [Microsoft iSCSI Boot Guide](http://technet.microsoft.com/en-us/library/ee619733(WS.10).aspx) ([http://technet.microsoft.com/en-us/library/ee619733\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/ee619733(WS.10).aspx))

Related references

- [Boot-from-SAN Tips](#)

About APM and Hyper-V

Pillar Axiom Path Manager (APM) supports Hyper-V on Windows Server platforms.

You can install APM on a Windows Server host configured as a Hyper-V parent. Multi-pathed Pillar Axiom LUNs that are mapped to the Hyper-V parent host can be accessed by the guest operating systems in the same way as other disks. For example, they can be used to hold Virtual Hard Disk (VHD) files, which can then be exposed to the guests, or the guests can access them as pass-through disks.

Guest operating systems can also use iSCSI software initiators to connect to Pillar Axiom systems and to access LUNs. In this case, APM maps the LUNs directly to the guest operating system. If the guest operating system has a version of APM that supports iSCSI, this version of APM can be installed on the guest and used to manage multiple iSCSI paths to the Pillar Axiom LUNs in the same way as APM would be used on a physical host.

Note: APM does not support the use of Hyper-V Virtual Fibre Channel in guest operating systems.

Refer to Microsoft [Hyper-V](http://www.microsoft.com/en-us/server-cloud/virtualization/default.aspx) (<http://www.microsoft.com/en-us/server-cloud/virtualization/default.aspx>) documentation for more information on using disks with Hyper-V.

About APM and Clustering

Pillar Axiom Path Manager (APM) can be used in a cluster environment. Refer to the operating system for information on cluster requirements and support. Additional information needed to support Pillar Axiom Path Manager (APM), in a cluster environment is presented below.

Pillar Axiom Path Manager (APM) can be used in a cluster environment where the configurations are supported by Microsoft. FC, FCoE, iSCSI, and Oracle Fabric Interconnect (formerly Xsigo) emulation are supported for use with APM and clustering if the components are both: certified by Microsoft for use with clustering; and supported by APM as described elsewhere in this manual.

The cluster environment must be set up and working before you install the APM for Windows software.

For information on setting up a cluster environment on Windows Server 2003 and Windows Server 2003 R2, refer to the following:

- [Quick Start Guide for Server Clusters](http://technet.microsoft.com/en-us/library/cc739757)
(<http://technet.microsoft.com/en-us/library/cc739757>)
- [Microsoft Knowledge Base article KB 301647](http://support.microsoft.com/kb/301647)
(<http://support.microsoft.com/kb/301647>)
- [Microsoft Support for Server Clusters with Third-Party System Components](http://support.microsoft.com/kb/814607/en-us)
(<http://support.microsoft.com/kb/814607/en-us>)

For information on setting up a cluster environment on Windows Server 2008 and Windows Server 2008 R2, refer to the [Microsoft Failover Clusters](http://technet.microsoft.com/en-us/library/cc732488(v=ws.10).aspx) ([http://technet.microsoft.com/en-us/library/cc732488\(v=ws.10\).aspx](http://technet.microsoft.com/en-us/library/cc732488(v=ws.10).aspx)).

Note: APM supports the type of clustering Microsoft refers to as failover clustering.

For information on setting up a cluster environment on Windows Server 2012, refer to the [Microsoft Failover Clustering Overview](http://technet.microsoft.com/en-us/library/hh831579.aspx) (<http://technet.microsoft.com/en-us/library/hh831579.aspx>).

Operating Limits

Pillar Axiom Path Manager (APM) provides access over multiple data paths to LUNs defined on a Pillar Axiom system.

APM and the Pillar Axiom software limit the following aspects of this access.

Table 5 APM operating limits

APM capabilities	Maximum value
Target Pillar Axiom systems	Eight for each SAN host
Connect to SAN Slammer storage controllers	Four for each Pillar Axiom system
Connect to LUNs	255 for each Pillar Axiom system
Handle data paths	32 to each LUN
Handle FC HBA ports	32 for each SAN host

Important! Not all combinations of the limits shown have been tested. Use care when operating a system that has been configured to run at or near these limits. The system may exhibit anomalies when all limits are exercised concurrently.

About FC SAN Component Support

The Pillar Axiom Path Manager (APM) software can be used on SAN hosts that use FC connections to SAN Slammers.

Note: If you are using Windows Server 2003 or Windows Server 2003 R2, you must update the Microsoft Storport driver. Refer to [Microsoft Knowledge Base article KB 932755](http://support.microsoft.com/kb/932755) (<http://support.microsoft.com/kb/932755>).

Related concepts

- [About Oracle Fabric Interconnect \(Xsigo Director\) Support](#)
- [HBA Driver and Software Requirements](#)

Related references

- [Supported FC HBAs](#)
- [Supported FC HBA Settings](#)
- [Supported FC Switches](#)
- [Supported Fibre Channel Over Ethernet CNA Requirements](#)
- [Supported Fibre Channel Over Ethernet Switches](#)

Related tasks

- [Configure a FC SAN](#)

Supported FC HBAs

This release supports all FC host bus adapters (HBAs) that meet the following requirements:

- The HBA has a Storport miniport driver. Other types of drivers, such as SCSIport miniport and monolithic drivers, are not supported.
- The HBA driver is digitally signed by the Microsoft Windows Hardware Compatibility Publisher for use on your version of Windows. These drivers are often described as Windows Hardware Quality Labs (WHQL) signed, WHQL certified, or Windows certified.
- The HBA driver is dated after January 1, 2008. In general, we recommend the most recent available driver that meets all of these conditions.
- The HBA is officially supported by the driver and meets all requirements specified for use with the driver, such as hardware version, firmware version, and bus slot capability.

Important! FC HBAs should be selected with care to ensure that they are suitable for use in a multipath environment with particular I/O loads. For example, some low-end HBAs have a low limit on the number of simultaneous connections that can be made from each port. This may make them unsuitable for use in an environment where they need to connect to several Slammer ports.

Install and configure the HBA and HBA driver according to the vendor documentation.

Suitable HBAs and drivers can be found in the Storage section of the [Windows Server Catalog](http://www.windowsservercatalog.com) (<http://www.windowsservercatalog.com>). In addition, the HBA vendor driver download page, or driver release notes, will usually specify that a driver is WHQL certified. After a driver is installed in the system, you can use the Windows Device Manager to check that it is appropriately signed.

Supported FC HBA Settings

Most FC host bus adapter (HBA) drivers have parameters that can be configured by utilities built into the HBA firmware, by utilities supplied by the HBA manufacturer, or through configuration files. Refer to your HBA vendor documentation to determine which parameters can be configured and how they are configured.

HBA settings control many aspects of HBA driver behavior, which can affect how Pillar Axiom Path Manager (APM) and Microsoft Multipath I/O (MPIO) deal with transient errors and other events in the SAN and in the Pillar Axiom system.

We recommend configuring the following aspects of HBA behavior for your HBAs to work well with APM:

- Allow a maximum of 64 commands to be outstanding on each target port.
- Wait at least 100 seconds after detecting a loss of link before reporting to the operating system that the link is down.
- Wait at least 30 seconds to retry access to a target port before assuming that the port or target has failed.
- Allow access to up to 256 LUNs per target.

The following HBA settings are recommend based on the manufacturer:

Table 6 Recommended QLogic HBA settings

Parameter	Value
Execution Throttle	64 maximum
Link Down Timeout	100 minimum
Port Down Retry Count	30 minimum
LUNs per Target	256

Table 7 Recommended Emulex HBA settings

Parameter	Value
QueueDepth	64 maximum
LinkTimeOut	100 minimum
NodeTimeOut	30 minimum
QueueTarget	1

We recommend setting any other configurable parameters according to the HBA manufacturer's recommendations, or to their default values, unless you have a particular requirement to set them to other values.

Refer to the *Pillar Axiom Support and Interoperability Guide*, which can be found on the [Oracle Technology Network](http://www.oracle.com/technetwork). Go to the Oracle Customer Support website: (<http://support.oracle.com/>) for additional information on HBAs not listed above.

Supported FC Switches

For a list of supported FC switches, you can:

- Contact Oracle Customer Support.
- Refer to the *Pillar Axiom Support and Interoperability Guide*, which can be found on the [Oracle Technology Network](http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html) (<http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html>).

Note: Refer to the vendor's website for the most recent installation instructions, patches, and firmware.

Related references

- [Oracle Contacts](#)

About Fibre Channel Over Ethernet Support

The APM software can be used on SAN hosts that use Fibre Channel over Ethernet (FCoE) connections from Converged Network Adapters (CNAs) through a switch to a FC SAN.

APM treats FCoE connections the same as FC connections.

Related references

- [Supported Fibre Channel Over Ethernet CNA Requirements](#)
- [Supported Fibre Channel Over Ethernet Switches](#)

Supported Fibre Channel Over Ethernet CNA Requirements

We require the following minimum driver and firmware requirements for the supported Fibre Channel over Ethernet (FCoE) converged network adapters (CNAs):

Table 8 Supported FCoE CNA settings

CNA models	Required versions
Emulex OCe10102-F	<ul style="list-style-type: none"> • Firmware and boot code: 2.102.200.28 or higher • Ethernet NDIS miniport driver: 2.102.200.13 or higher • FCoE Storport miniport driver: 2.32.002 or higher
Brocade 1010 and 1020	<ul style="list-style-type: none"> • Boot code, from multi-boot image: 2.2.0.0 or higher • Drivers, from driver package: 2.2.0.0 or higher
QLogic QLE8150 and QLE8152	<ul style="list-style-type: none"> • Boot code, from multi-boot image: 1.01.54 or higher • Ethernet NDIS miniport driver: 1.0.1.0 or higher • FCoE Storport miniport driver: 9.1.8.26 or higher • iSCSI Storpoint miniport driver: 2.1.5.37 or higher

Note: The FCoE CNAs can also be used concurrently as Ethernet network interface controllers (NICs) as well, in some instances, depending upon the manufacturer, as an iSCSI HBA. We recommend that the latest firmware versions available from the CNA vendors should be used.

Supported Fibre Channel Over Ethernet Switches

The supported Fibre Channel over Ethernet (FCoE) converged network adapters (CNAs) were tested in conjunction with the Brocade 8000 switch.

For best results, the Brocade 8000 switch must be running Fabric OS version 6.4.0a or higher.

About Oracle Fabric Interconnect (Xsigo Director) Support

Oracle Fabric Interconnect (formerly Xsigo Director) and associated Oracle Virtual Networking host software provide Ethernet and FC emulation over InfiniBand.

The FC ports on the Oracle Fabric Interconnect (Xsigo Director) must connect to the FC fabric through an N_Port ID Virtualization (NPIV)-aware FC switch. Direct connection of the Oracle Fabric Interconnect (Xsigo Director) to the Pillar Axiom system is not supported.

In addition to FC emulation, Pillar Axiom Path Manager (APM) also supports the Ethernet emulation provided by the solution. The Oracle Fabric Interconnect (formerly Xsigo) virtual Ethernet network interface controllers (NICs) are supported in the same ways as other Ethernet NICs.

Refer to the [Oracle Fabric Interconnect \(Xsigo\) documentation](http://docs.oracle.com/cd/E38500_01/index.html) (http://docs.oracle.com/cd/E38500_01/index.html) for instructions on setting up and configuring the Oracle Fabric Interconnect (Xsigo Director) and associated components. The InfiniBand host channel adapters (HCAs) and other equipment required for this solution are specified in the documentation.

Supported Oracle Fabric Interconnect (Xsigo) Drivers

Hosts using the Oracle Fabric Interconnect (formerly Xsigo) should use the following firmware and software at a minimum, though the latest versions available from Oracle are recommended:

- XgOS: version 2.7.1.1 or higher
- XMS: version 2.7.1 or higher
- HCA firmware: version 2.7.9 or higher
- Drivers: version 2.6.0.6 or higher

For access to the Oracle Fabric Interconnect (Xsigo) drivers, refer to the Oracle Technology Network at [Xsigo Downloads](http://www.oracle.com/technetwork/server-storage/xsigo-1870185.html) (<http://www.oracle.com/technetwork/server-storage/xsigo-1870185.html>).

For additional product information on Oracle Fabric Interconnect (Xsigo), refer to the [Oracle Technology Network Documentation](http://www.oracle.com/technetwork/documentation/oracle-net-sec-hw-190016.html) (<http://www.oracle.com/technetwork/documentation/oracle-net-sec-hw-190016.html>).

About iSCSI Software and Hardware Support

The Pillar Axiom Path Manager (APM) software can be used on SAN hosts that use iSCSI connections to SAN Slammers.

Related concepts

- [Supported iSCSI Software](#)
- [HBA Driver and Software Requirements](#)

Related references

- [Supported iSCSI HBAs](#)
- [Supported iSCSI-to-FC Routers](#)
- [Supported iSCSI Switches](#)

Supported iSCSI Software

If you intend to use iSCSI, you must enable and configure the Microsoft iSCSI Initiator.

For Windows Server 2003 and Windows Server 2003 R2:

- Download and install version 2.08 or later of the Microsoft iSCSI Initiator from Microsoft.
- If you plan to boot from a NIC using the iSCSI Boot Firmware Table (iBFT), ensure that you have the boot version of the Microsoft iSCSI Initiator.

For more information on the Microsoft iSCSI Initiator and links to download packages, refer to the [Microsoft Storage Technologies - iSCSI](http://go.microsoft.com/fwlink/?LinkID=44352) page (<http://go.microsoft.com/fwlink/?LinkID=44352> "Microsoft iSCSI Initiator page").

For Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012:

- The iSCSI Initiator is a standard part of the OS.
- Use Windows Update to ensure that you have the latest version.

For more information, refer to the [Microsoft iSCSI Initiator Step-by-Step Guide](http://technet.microsoft.com/en-us/library/ee338476(WS.10).aspx) ([http://technet.microsoft.com/en-us/library/ee338476\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/ee338476(WS.10).aspx)).

Related tasks

- [Configure iSCSI Connections for SAN](#)

Supported iSCSI HBAs

The following information lists supported and tested QLogic HBAs and drivers, and the versions of software and firmware required to use these HBAs with Pillar Axiom Path Manager.

Below is the list of supported HBA models:

- QLA4050
- QLA4050C
- QLA4052C
- QLA4060C
- QLA4062C

Below are the required software or firmware versions:

- BIOS: 1.15 or higher
- iSCSI firmware: 3.0.1.53 or higher
- Storport Driver: 2.1.5.37 or higher
- QLogic Converged Network Adapters in iSCSI mode are also supported

Supported iSCSI-to-FC Routers

iSCSI-to-FC routing features enable a host to use iSCSI to access LUNs through FC ports on Pillar Axiom SAN Slammers.

APM supports the iSCSI-to-FC routing features of the Cisco MDS 9000 family of multilayer directors and fabric switches. The only supported iSCSI-to-FC routing solution is the solution provided by this family of switches.

The iSCSI-to-FC features were tested on Cisco MDS SAN-OS Release 3.0 (2a).

For more information on these features, refer to the [Cisco documentation](http://www.cisco.com/) (http://www.cisco.com/).

Related tasks

- [Configure the iSCSI-to-FC Router](#)

Supported iSCSI Switches

For a list of supported iSCSI switches:

- Refer to the *Pillar Axiom Support and Interoperability Guide*, which can be found on the [Oracle Unified Storage Systems Documentation](http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html) website (<http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html>).
- Call Oracle Customer Support.

Note: Refer to the vendor's website for the most recent installation instructions, patches, and firmware.

CHAPTER 2

Install APM

About APM Software Installation

After you prepare your SAN for Pillar Axiom Path Manager (APM) as described in the first half of this chapter, you can download and install the APM software. After the installation, configure your SAN host and the Pillar Axiom software so that they can work together.

The APM installation requires that you download the APM software installation package from the Oracle Technology Network (OTN) and install the software on your system.

After you install APM, configure access from the SAN host to Pillar Axiom LUNs.

Updating an existing APM installation is a separate task.

APM Preinstallation Requirements

Before you install the Pillar Axiom Path Manager (APM) software, ensure that your network and Pillar Axiom system meet the installation requirements.

To function fully and properly, APM requires a network connection to the Pilot management controller and installation of one or more of the following:

- Fibre Channel host bus adapter (HBA) or Converged Network Adapter (CNA) cards and drivers.
- For a hardware iSCSI installation, iSCSI HBAs and the Microsoft iSCSI Initiator.
- For a software iSCSI installation, network interface cards (NICs) and the Microsoft iSCSI Initiator.

Management Network Requirements

The Pillar Axiom Path Manager (APM) software communicates with the Pilot over secure, encrypted XML. The SAN host on which the APM software is installed requires a TCP/IP connection for communication with the Pillar Axiom Storage Services Manager.

The network configuration must allow the SAN host to connect to TCP port 26004 on the Pilot's management Ethernet interfaces to connect the control path. Connecting to the control path is optional if you are using the APM configuration from the host feature. This connection is used to implement the control path, so it is optional but recommended.

Network firewalls may be running on the host or in the network between the host and the Axiom Pilot. Firewall settings may block access to port 26004 and changes to the settings may block a port which was previously open. Operating system security updates may change the configuration of any firewall running on the host. If the host cannot access port 26004 on the Axiom Pilot, APM, in the Pillar Axiom Storage Services Manager **Hosts** page is shown as **Not Communicating**.

To resolve this issue, verify the TCP port, 26004, is not blocked. You can test connectivity from the host to the Pillar Axiom storage system with the `telnet` command to access the Pillar Axiom storage system. You will need the IP or DNS name of the Pillar Axiom storage system. If you can successfully access the Axiom with the `telnet` command, no data is returned from the Pillar Axiom storage system and you will need to quit or escape from the session

Here is an example of the command:

```
telnet axiom_ip_or_dns_name 26004
```

Related concepts

- [About Configuration at the Host](#)

HBA Driver and Software Requirements

You must set up the Microsoft iSCSI Initiator or FC host bus adapters (HBAs) and their required software before you can access LUNs on a Pillar Axiom system and use the Pillar Axiom Path Manager software.

Perform the following actions:

- Install or update the Microsoft iSCSI Initiator if you plan to use iSCSI.
- Install any FC or iSCSI HBAs, or Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs), that you plan to use.
- If the supported driver versions for your HBAs or CNAs are not already installed, install them.
- If necessary, update the firmware and BIOS on iSCSI HBAs or FCoE CNAs to the supported versions.
- Verify that your HBA configurations meet the specified requirements.

Microsoft Service Pack and Hotfix Requirements

Install the applicable Microsoft service packs and hotfixes for your operating system before you install the APM software.

For both Windows Server 2003 and Windows Server 2003 R2, install Service Pack 2. In addition, install Microsoft's Storport Hotfix from [Microsoft Support](http://support.microsoft.com/kb/932755/en-us) (<http://support.microsoft.com/kb/932755/en-us>).

Note: Install Hotfix 932755 *after* you install Service Pack 2 on Windows Server 2003 or Windows Server 2003 R2.

APM 3.4 supports Windows Server 2008 with or without Service Pack 2.

Configure a FC SAN

- 1 Verify that the HBAs, HBA drivers, and required HBA vendor software are installed on the host according to the vendor's instructions.
- 2 Set up the SAN (physical connectivity and any required switch zoning) so there is at least one path through the SAN between an HBA port on the host and a Slammer port on each Pillar Axiom system.

This enables the APM Service to discover the Pillar Axiom systems and automatically create host entries in the Pillar Axiom Storage Services Manager.

- 3 From the Pillar Axiom Storage Services Manager, check the connection in the **SAN > Storage > Hosts** page for the following:
 - The host port should appear as an entry with the **Host Name** shown as **Hostname Unknown**.
Note: The host page will display the host name after you install APM.
 - The **Host Port** name should be shown as its port WWN.

Configure the iSCSI-to-FC Router

This release supports the iSCSI-to-Fibre Channel routing features of the Cisco MDS 9000 family of multi-layer directors and fabric switches. These features require configuration to work with the Pillar Axiom Path Manager (APM) and the Pillar Axiom system.

For more information on these features, refer to the [Cisco documentation](http://www.cisco.com/en/US/products/ps10495/products_installation_and_configuration_guides_list.html) (http://www.cisco.com/en/US/products/ps10495/products_installation_and_configuration_guides_list.html).

- 1 Present the Pillar Axiom Slammer storage controller ports as iSCSI targets.

Choose **Dynamic Mapping** or **Static Mapping**. However, we recommend that you use dynamic mapping because the main Cisco features for static mapping requirements are supplied by APM and the Pillar Axiom Storage Services Manager.

- 2 Present the iSCSI hosts as virtual FC hosts.

The hosts must be presented in transparent initiator mode (not in proxy-initiator mode). When you assign World Wide Names (WWNs) for the iSCSI initiators, use the static mapping mechanism.

After you configure the switch, APM on the iSCSI hosts interacts with the Pillar Axiom systems in exactly the same way as when both hosts and Slammers use the same SAN protocol.

Configure an iSCSI SAN

- 1 Verify that the Microsoft iSCSI Initiator and TCP/IP networking are installed and configured on the host.
- 2 If you are using an iSCSI-to-FC router, configure the router functionality and set up the FC SAN between the FC ports on the router and the FC ports on the Slammers.
- 3 Set up the TCP network between the host and the iSCSI ports on the Slammer or the iSCSI-to-FC router.
- 4 After completing the above steps, configure iSCSI connections as described later in this manual.

Configure iSCSI Connections for SAN

Follow this procedure to use the Microsoft iSCSI initiator to make iSCSI connections using NICs or HBAs.

- 1 Launch the iSCSI initiator.
- 2 On the **Discovery** tab, click the button to add or discover a target portal, and add the IP address of one of the following:
 - A Slammer port on each Slammer.
 - An iSCSI port on the iSCSI-to-FC router that represents the Slammer ports.

Result:

An entry for each Pillar Axiom system should be listed on the **Targets** tab.

- 3 On the **Targets** tab, select a Pillar Axiom system or the representation of a Pillar Axiom system on an iSCSI-to-FC router.
- 4 Click **Log On** (or **Connect**).
- 5 Select **Automatically Restore this Connection** (or **Add this connection to the list of Favorite Targets**) and **Enable Multi-path**.
- 6 Click **Advanced**.
- 7 In the Advanced Settings dialog box, select a **Local Adapter**, **Source IP** (or **Initiator IP**), and **Target Portal** that represent the ends of the connection you are creating.

Note: Each connection forms a path to the Pillar Axiom systems. You will need to repeat these steps for each possible combination of these fields.

- 8 Click **OK** to close the Advanced Settings dialog.
- 9 Click **OK** to close the Log On to Target (or Connect to Target) dialog.
- 10 Repeat Steps 4 through 9 for each available combination of **Local Adapter**, **Source IP** (or **Initiator IP**), and **Target Portal**, up to a maximum of 32 combinations for each Slammer.
- 11 Repeat Steps 3 through 10 for each target that represents a Pillar Axiom system.

Download and Install the APM Software

To install the Pillar Axiom Path Manager (APM) software, download the APM for Windows package, install the package, and configure your Pillar Axiom system to work with APM.

Prerequisites:

- Install any applicable Microsoft service packs and hotfixes.
 - Configure the SAN. Follow the instructions listed previously in this chapter.
 - Verify that your system meets the preinstallation requirements.
- 1 Download the APM software.
 - 2 Install the APM software if you are installing APM for the first time.
 - 3 Complete the installation by configuring access from the SAN host to Pillar Axiom LUNs.
- If you are updating an existing APM installation, see the instructions for updating the APM software.
 - To remove the software from your SAN host, see the instructions for removing the APM software.

Related concepts

- [APM Preinstallation Requirements](#)

Related tasks

- [Download the APM Software](#)
- [Install the APM Software](#)
- [Configure SAN Host Access to the Pillar Axiom LUNs](#)
- [About Updating the APM Software](#)
- [Remove the APM Software \(Optional\)](#)

Download the APM Software

The software and documentation are distributed as a single zip archive that is available for download from the Oracle Technology Network.

Prerequisite: Join the [Oracle Technology Network](http://www.oracle.com/technetwork/community/join/why-join/index.html) (<http://www.oracle.com/technetwork/community/join/why-join/index.html>) to gain access to software and documentation downloads.

- 1 On the Oracle Technology Network, open the [Pillar Axiom Downloads](http://www.oracle.com/technetwork/server-storage/san-storage/downloads/index.html) page (<http://www.oracle.com/technetwork/server-storage/san-storage/downloads/index.html>) in your browser.
- 2 Under the Pillar Axiom Downloads title, select **Accept License Agreement** to be able to download the software package.
- 3 Click the name of the software package to download.
- 4 Extract the contents of the software bundle archive to a local drive connected to your SAN host.

The archive contains software installation packages for all supported hardware platforms, as well as documentation, for the specified APM. Extract the package on a local drive for your hardware platform and the documentation.

After you download the software, you can install it on your host system.

Install the APM Software

Follow these instructions to install the Pillar Axiom Path Manager (APM) software on the host, if another version of APM is not already installed.

If you are updating from a previous version of the software, see the instructions for updating the APM software.

- 1 Verify that you have administrator privileges to install the software.
- 2 Close all applications and management applets.
- 3 On Windows Server 2003 and Windows Server 2003 R2 hosts with mirrored disks, stop the `dmadmin` service.
- 4 To install the software, choose one of:
 - From Windows Explorer, double-click the name of the APM package you downloaded.
 - From the command line, run the following command:

```
msiexec /i package_name
```

Result:

Either option installs the following components:

- Microsoft Mutipath I/O (MPIO).

On Windows Server 2003 and Windows Server 2003 R2, the Microsoft MPIO 1.23 framework is installed.

On Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012, the Multipath I/O feature, which is part of the operating system, is installed, if it is not already installed.

- The Pillar Device-Specific Module (DSM).
- The APM service.
- The sample WMI script.

5 Restart the system if you are prompted to do so.

6 On Windows Server 2003 and Windows Server 2003 R2, where hosts use mirrored disks, restart the `dmadmin` service.

Related concepts

- [About Updating the APM Software](#)

Configure SAN Host Access to the Pillar Axiom LUNs

The LUN configuration procedure provides the SAN host with access to Pillar Axiom LUNs.

Perform the following steps for both iSCSI and FC.

- 1 Open the **Storage > SAN > Hosts** page in the Pillar Axiom Storage Services Manager.
- 2 Verify that the individual entries for the host ports have been replaced with a single entry under the host name.

Example:

Figure 2 Example host ports before APM installation

Host Name	Host Port	Type	AxiomONE Path Manager	Number of LUNs	Host Port Status
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:36:84:6e	FC	Not Registered	0	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:36:84:6f	FC	Not Registered	0	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:36:85:20	FC	Not Registered	6	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:41:32:c3	FC	Not Registered	0	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:41:32:c4	FC	Not Registered	0	Connected
<input type="checkbox"/> iqn.1987-05.com.cisco:01.eca9a9b8d555	192.168.2.93	iSCSI	Not Registered	0	Connected
	192.168.2.94	iSCSI			Connected

Figure 3 Example host ports after APM installation

Host Name	Host Port	Type	AxiomONE Path Manager	Number of LUNs	Host Port Status
<input type="checkbox"/> happy	10:00:00:00:c9:36:84:6e	FC	Communicating	0	Connected
	10:00:00:00:c9:36:84:6f	FC			Connected
	192.168.2.93	iSCSI			Connected
	192.168.2.94	iSCSI			Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:36:85:20	FC	Not Registered	6	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:41:32:c3	FC	Not Registered	0	Connected
<input type="checkbox"/> Hostname Unknown	10:00:00:00:c9:41:32:c4	FC	Not Registered	0	Connected

Note: The Hosts page may display differently in your version of Pillar Axiom Storage Services Manager.

The automatic configuration of a host entry occurs when APM discovers the Pillar Axiom system on the SAN and then makes a control path connection to the Pilot. If you are using APM without a control path connection, you will need to manually create a host entry in the GUI and associate all host FC port WWNs and iSCSI initiator names with that entry.

You will see one or more of the following **Axiom Path Manager Status** and **Host Port Status** messages on the Hosts page:

APM Status **Communicating:** The host control path is currently logged into the Pilot.

Note: **Communicating** status is required for the APM control path to report path status, configure load balancing, and use the Pillar Axiom system to collect APM diagnostic logs. However, the configuration at the host feature makes it possible to configure load balancing locally when the status is other than **Communicating**.

Not Registered: A control path from an APM host with this name has never logged into the Pilot.

Not Communicating: The APM host control path has previously logged into the Pilot, but it is not currently logged in.

Host Port Status **Connected:** The host SAN connection is logged in to the SAN Slammer.

Not connected: The host SAN connection is not logged in to the SAN Slammer.

See the Pillar Axiom Storage Services Manager Help for information about the remaining fields on the Hosts page.

- 3 Connect and enable any additional paths through the SAN between the host and the Slammers.
- 4 Create any new LUNs on the Pillar Axiom system for this host, and set up any mappings of LUNs to the new host entry.

Note: Windows does not recognize LUN number 255. If you configure a LUN for the host at LUN number 255, it will not be seen by Windows.

- 5 The LUNs should appear automatically on the host. If they do not appear, select **Rescan Disks** in the Windows Disk Manager.

Result:

The LUNs should become available as drives on the host. If the drives do not appear, restart the host.

- 6 Go to the **Storage > SAN > Hosts** page in the Pillar Axiom Storage Services Manager, and select the entry for the new host.
- 7 Select the **View** or **Modify** action for the new host entry, and select the LUN Connections tab.

It may take some time for the names to appear in the LUN Name on Host column on the Hosts page.

Tip: If the names are not visible within two or three minutes, you may need to refresh the screen to see them.

Result:

The LUNs that are mapped to the host, and the connection state between the host ports and the Slammer ports, are displayed. If the APM control path is communicating, each LUN name as allocated by Windows on the host, along with the numbers of optimized and non-optimized paths currently being controlled by APM, are also displayed.

- 8 Format and set up the drives for use in Windows.

Note: On Windows Server 2003 and Windows Server 2003 R2, the Microsoft iSCSI Initiator supports formatting iSCSI LUNs as basic (not dynamic) drives only.

- 9 (Optional). Click the **Settings** tab to change the load balancing algorithm used on this host for each LUN, if the control path is communicating.

Related concepts

- [About Configuration at the Host](#)

Boot-from-SAN Tips

The following information provides tips to ensure that the Pillar Axiom Path Manager (APM) functions properly in a boot-from-SAN environment.

Important! Setting up a SAN with network boot technology has many hardware dependencies and deployment scenarios that are beyond the scope of this document. Refer to your Microsoft Windows and hardware vendors' documentation for details.

Note: Fibre Channel Arbitrated Loop (FCAL) is not supported for boot-from-SAN.

Related concepts

- [About Boot from SAN](#)
- [About Boot LUNs](#)
- [About Boot Device Failover](#)
- [About Boot Device Paths](#)

Related tasks

- [Clone a Boot LUN](#)

About Boot LUNs

When you create a LUN and install Windows on it to use as the boot LUN for the host, we recommend that you set the boot LUN to high priority. If you do not choose high priority, the host may exhibit sluggish performance when the Pillar Axiom system is under heavy load.

Note: Microsoft recommends putting the pagefile on local storage to ensure that access to the pagefile cannot be affected by events on the SAN.

About Boot Device Paths

Note the following regarding boot device paths:

- Verify that the boot device path is set up correctly; otherwise, the system may not start up.
- When the Pillar Axiom Path Manager (APM) software is not used, there must be only a single path through the SAN between the host and the boot LUN. Without APM, if more than one path is visible to Windows, the host may fail to boot, and the boot LUN may become corrupted.

Important! Losing all paths to the boot device will cause system failure.

- The exact mechanism used by the host to identify boot and pagefile paths varies with host boot system and HBA design.

For example, details of the various FC ports in the path may be stored as part of the path definition. If you later change your SAN configuration so that details of the path are changed, the host may not be able to access the LUN using the path definition it stored earlier, even if access is still possible through other similar paths.

Actions that may cause details of the path to change include moving cables to different ports, reconfiguring zones, or changing port masking for a LUN.

About Boot Device Failover

The APM drivers must load before the boot device can fail over. These drivers usually load before the login prompt displays.

Important! Losing the boot path before this point will cause system failure.

Clone a Boot LUN

You can create a clone of a Windows boot LUN as a safety archive, or to set up a number of similar boot-from-SAN hosts. The host must not be booted from the LUN when a clone is made.

- 1 Shut down the host.
- 2 Use the Pillar Axiom Storage Services Manager Clone LUN feature to create a clone of the LUN.

Refer to the *Pillar Axiom Administrator's Guide*.

- 3 Remove the host mappings from the original LUN.
- 4 Change the original LUN number to some other LUN number.
- 5 Assign the original LUN number to the clone.
- 6 Map the clone to the host.
- 7 Restart the host.

About Load Balancing Configurations

APM can be configured for static or round-robin load balancing. You can configure load balancing separately for each LUN.

In static load balancing, the software selects the best available path and all commands are sent over that path until the path is no longer operational or a better path becomes available. Then, a failover to another appropriate path is initiated.

In round-robin load balancing, commands are sent by turn over the best available paths. This ensures that LUN commands are evenly distributed over any path that is available to access the LUNs. Round-robin load balancing is the default method to manage data paths.

Load balancing allows the paths to share the load in different ways:

- Balances access to a LUN across all optimized Slammer ports available for that LUN
- Balances access from a host across the host's HBA channels

To configure round-robin or static load balancing through the Pillar Axiom Storage Services Manager, refer to the *Pillar Axiom Administrator's Guide*.

Note: Various Windows configuration tools report the load balancing settings for multi-pathed LUNs and provide options to modify them. Static load balancing is reported as *Fail Over Only* and round-robin load balancing as *Round Robin With Subset*.

You can use the Pillar Axiom GUI or CLI to change these load balancing settings from the Pillar Axiom system, or you can change them from the host using Windows applets or WMI processes. If you change load balancing settings from the host and leave the APM control path connection communicating with the Pilot, the Pillar Axiom system may override your changes. Running APM without a control path connection ensures that the Pillar Axiom system cannot override your changes, but other control path functions will not be available.

Note: On Windows Server 2003 and Windows 2003 R2, LUNs used as Microsoft cluster disk resources use static load balancing regardless of how they are configured. Windows Server 2008, Windows 2008 R2, and Windows Server 2012 cluster disk resources support both static and round-robin load balancing.

Related concepts

- [About Path Selection](#)

About Path Selection

Pillar Axiom Path Manager (APM) selects the best paths to access Pillar Axiom LUNs.

Path selection is based on three factors:

- Path optimization state
- Path performance
- Path availability

Path optimization is determined by the Slammer control unit (CU) that the path uses. An *optimized path* is a path that connects through the Slammer CU on which the LUN is currently resident, or *homed*. A *non-optimized path* is a path that connects through the alternate Slammer CU. The LUN can be accessed through the alternate CU, but the LUN is not resident on the alternate CU. Optimized paths are always preferred, but if an optimized path is not available, the non-optimized path can be used temporarily.

Path performance is determined by how quickly and reliably a path transfers I/O traffic to and from a LUN. Generally, FC paths perform better than iSCSI paths, so FC paths are preferred over iSCSI paths.

Note: In this discussion, FC includes FC HBA as well as FCoE CNAs.

Path availability is determined by the ability of the path to transfer I/O traffic. An available path is fully functional but if the path stops working, the path is considered unavailable.

These factors determine how the paths to each Pillar Axiom LUN are divided into groups.

APM groups the paths in the following order of preference:

- First, FC optimized
- Next, iSCSI optimized
- Next, FC non-optimized
- Finally, iSCSI non-optimized

For each LUN, the currently configured load balancing algorithm is used to select paths from the most preferred group that has paths available. Only paths from a single group are used at any one time.

When an active path fails, I/O traffic is transferred to a different path. I/O performance is reduced for a short time while the operating system recognizes the failure and makes the path transfer. After the path transfer is complete, I/O performance improves.

If the failing path is optimized and the new path is non-optimized, I/O performance might continue to be reduced after path transfer because a lower-performance path is in use. Within a few minutes of traffic being transferred to a non-optimized path, the Pillar Axiom system attempts move the LUN to the appropriate Slammer CU to make the path optimized. After transfer to an optimized path succeeds, I/O performance improves.

About Updating the APM Software

In this release, directly updating the Pillar Axiom Path Manager (APM) software is not supported for all configurations of Windows Server. The update path you need to follow depends on your Windows Server configuration:

- **Windows Server in a clustered environment:** The cluster node being updated should be Passive. This should allow I/O to the cluster to continue without interruption. Changing the roles of the nodes from Active to Passive will allow all nodes to be updated.

Note: The act of changing the nodes from Active to Passive will introduce a disruption.

- **Any Windows Server 2008, Windows Server 2008 R2, or Windows Server 2012 configuration:** You can update the APM software directly. Follow the installation instructions in this guide for installing APM when it is not already installed. This installation will automatically replace the existing version with the new one.
- **Windows Server 2003 and Windows Server 2003 R2, configurations in which the host is booted from a Pillar Axiom LUN:**
 - First remove the previous version of APM by following the instructions in the appropriate *Pillar Axiom Path Manager Installation Guide and Release Notes*.
 - Then install APM following the installation instructions in this guide.
- **Other Windows Server 2003 and Windows Server 2003 R2 configurations** where the host is **not** booted from a Pillar Axiom LUN, follow the update instructions for APM with Windows Server 2003.

Related tasks

- [Download the APM Software](#)
- [Install the APM Software](#)
- [Configure SAN Host Access to the Pillar Axiom LUNs](#)
- [About Updating the APM Software](#)
- [Remove the APM Software \(Optional\)](#)
- [Update the APM Software on Windows Server 2003](#)

Update the APM Software on Windows Server 2003

Follow this procedure to update the Pillar Axiom Path Manager (APM) software on a Windows Server 2003 or Windows Server 2003 R2 configuration where the host is **not** booted from a Pillar Axiom LUN.

- 1 Disconnect all Fibre Channel (FC) and iSCSI paths from the host to the Pillar Axiom system.
- 2 Reboot the host.
- 3 Install the new version of APM by following the instructions in this guide for installing APM if another version of APM is not installed.
- 4 Reboot the host at the end of the installation.
- 5 Log in to the host.
- 6 Reconnect the FC and iSCSI paths to the Pillar Axiom system.

Remove the APM Software (Optional)

When you remove the Pillar Axiom Path Manager (APM) software, support for multiple paths to Pillar Axiom LUNs is removed.

Important! Before you remove the software, you must disconnect the host from all Pillar Axiom systems if you do not want to access Pillar Axiom LUNs. Microsoft requires that, before removing MPIO support for a device, there must be a maximum of one path connected to the device and, if a path is left connected, that I/O to the device should be stopped or made as low as possible. If you want to continue LUN access, reconfigure the SAN so that there is only a single Fibre Channel path or iSCSI connection from the host to each Pillar Axiom Slammer.

- 1 Verify that all applications and management applications are closed.

Important! It may take several minutes for Windows to recognize that paths or LUNs have been disconnected from the host. It is vital that you wait until Windows has recognized that these changes have been made and completed updating its configuration before you proceed to remove APM.

You can use the Windows Device Manager to check the paths and LUNs that Windows currently has in its configuration. Selecting **Scan for hardware changes** in Device Manager may help Windows recognize the changes more quickly.

Wait until Device Manager shows that all Pillar Axiom LUNs have been removed (or that all Pillar Axiom LUNs have a maximum of one path remaining if you have chosen to leave the LUNs connected) before closing Device Manager and removing APM.

- 2 Use one of the following to remove APM:

- Windows Server 2003 or 2003 R2 **Add or Remove Programs** Control Panel.
- Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012 **Programs and Features** Control Panel.
- Enter the following at a command line prompt:

```
wmic product where name="Pillar Axiom Path Manager"  
call uninstall
```

This command may prompt you for a response.

Note: If Windows requires a reboot after uninstalling using this command, it will reboot the system immediately without warning or asking for confirmation.

Tip: Sometimes the uninstall process may take longer than expected on the host, and the process may appear to be hanging. Allow the process to run for at least an hour before attempting to restart it.

- 3 (Optional). In Windows Server 2008, Windows Server 2008 R2, or Windows Server 2012, you may choose to remove the Multipath I/O feature after removing APM, if nothing else is using it.
- 4 If you are prompted to do so, restart the system.

Note: If access to a LUN is lost, you can use the Disk Administrator to reactivate the drive on one of the paths that is showing. If the path that the Disk Administrator can see is missing, restore the path and then choose **Reactivate Disk**.

There are situations in which you might be tempted to remove or update the `pillardsm.sys` driver or a component of Microsoft's MPIO multi-path disk framework using the device and driver property pages in the Windows Device Manager.



Do not use anything but **Add or Remove Programs** (Windows Server 2003 or 2003 R2), **Programs and Features** (Windows Server 2008, Windows Server 2008 R2, or Windows Server 2012), or the `wmic` command described above to change your installation because other tools may leave the system in an inconsistent state, possibly preventing subsequent system startups. These commands ensure that all components are left in a consistent state. If any of these command fails to remove APM, contact Oracle Customer Support.

Important! Uninstalling MPIO from a Windows Server 2003 or 2003 R2 host that is booted from a multipathed iSCSI LUN may cause problems. Refer to [Microsoft Knowledge Base Article 952775](#) before uninstalling APM from a host that is booted over iSCSI from a Pillar Axiom LUN.

CHAPTER 3

APM Release Notes

New in This Release

Pillar Axiom Path Manager 3.4 for Windows supports Windows Server 2012.

Known APM Issues

The following Pillar Axiom Path Manager (APM) issues are known in this release.

Table 9 Known APM issues

Issue	Workaround or planned fix
Windows Only [15977560 14376489] In Windows Server 2008 and later, the APM installation occasionally fails to add the Multipath I/O feature. In this case Windows presents each path to each LUN as a separate disk, with only one disk enabled for each LUN.	Go to the Windows server, select Features section in Server Manager and add the Multipath I/O feature.
Windows Only [16524276] When using Windows Device Manager to view the device properties of an Axiom disk, the MPIO Path Details screen shows invalid data for the storage controller ID and State associated with the path to the Axiom.	This issue will be fixed in a future release of APM.

Known Pillar Axiom Issues

The following issues might be associated with the version of the Pillar Axiom software you are using.

Table 10 Known Pillar Axiom issues

Issue	Workaround or planned fix
<p>[13759030] If an iSCSI initiator is connected to a port on a Slammer, and that Slammer CU is powered off, the LUN and Host GUI pages continue to show the connection status for the iSCSI initiator as <i>Connected</i>.</p>	<p>This issue is fixed in release 5.0 of the Pillar Axiom software.</p>
<p>[13759805] If more than 256 SAN LUNs are configured on a Pillar Axiom system, the Pillar Axiom Storage Services Manager may send invalid messages to the APM daemon running on SAN host systems.</p> <p>When this happens, the control path connection between APM and the Pillar Axiom will continually move between <i>Communicating</i> and <i>Not Communicating</i> states. This prevents features that depend on the APM control path (such as setting the load balancing algorithm) from working properly. The data path, which manages LUN access from the host, is not affected.</p>	<p>This issue is fixed in release 5.0 of the Pillar Axiom software.</p>
<p>[13764561] The Pillar Axiom Storage Services Manager (GUI) sometimes continues to display host paths that are no longer valid after APM stops.</p> <p>This is because APM is no longer communicating path information to the GUI, so the GUI continues to display the host paths as they were while APM was running.</p>	<p>This issue is fixed in the 5.4 Pillar Axiom software.</p>

Table 10 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
<p>[13764609, 13762326] While the system is recovering from temporary use of non-optimized paths to the alternate CU on a Slammer, you may notice a decrease in I/O performance between a LUN and a Slammer CU.</p>	<p>This issue is fixed in release 4.5.1 and 5.2.1 of the Pillar Axiom software.</p> <p>If the Pillar Axiom system is running a release earlier than 4.5.1 or 5.2.1, you can take the following actions:</p> <ol style="list-style-type: none"> 1 Follow the instructions in the <i>Pillar Axiom Administrator's Guide</i> to rehome the LUN to the alternate CU on that Slammer. 2 Rehome the LUN again to the original CU on that Slammer. <p>Contact Oracle Customer Support for assistance.</p>
<p>[14576187] When you remove APM from a host and then delete the host entry in the Pillar Axiom Storage Services Manager (GUI), that host's initiators are considered unassociated. If you then attempt to use the GUI to associate one of the host initiators to another host, the association fails with the error <code>Unsatisfied request due to internal error</code>.</p>	<p>Use the Pillar Axiom CLI, not the GUI, to form the association.</p> <p>This issue is fixed in the 5.4 Pillar Axiom software.</p>
<p>[14581579] A defect in the Pillar Axiom software prevents proper creation of an APM host entry in the management server when there are more than 1024 LUN mappings to the initiators associated with the host, and the mappings differ between the initiators. You can recognize this defect in the Pillar Axiom Storage Services Manager (GUI) when the following symptoms occur together:</p> <ul style="list-style-type: none"> • The APM host is not communicating. 	<p>This issue was fixed in the 5.4 Pillar Axiom software.</p> <p>For Pillar Axiom software version 5.3 or earlier, take the following actions:</p> <ol style="list-style-type: none"> 1 Stop the APM service on the host. 2 Manually reconcile the mappings on all of the host initiators so that all initiators see the exact same set of LUNs via the same LUN number. 3 Restart the APM service to enable the host to configure itself.

Table 10 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
<ul style="list-style-type: none">The system displays the following TaskFailed system alert: <code>UNSATISFIED_REQUEST_PMI_COMMUNICATION_ERROR</code>	
<p>[14747038] The Pillar Axiom software is sometimes unable to configure the load balancing setting for LUNs on APM hosts. Attempts to change the load balancing setting through the Pillar Axiom Storage Services Manager (GUI) or CLI fail with the following error:</p> <pre>Unsatisfied request due to internal error</pre>	This issue was fixed in the 5.4 Pillar Axiom software.

Known Operating System Issues

The following operating system issues can have an impact on running Pillar Axiom Path Manager (APM) on Windows systems.

[36166] APM Installation Hangs

Occasionally, installation of MPIO-based components (such as APM) may hang if any I/O is happening at the time to any disk subsystems controlled by MPIO.

Messages such as `Restarting all SCSI adapters` may be displayed while installation is suspended.

If this happens, restart the host and try the install or upgrade process again. Microsoft specifies that I/O to MPIO-managed disk subsystems should be low or quiescent during the install.

[13746944] Multiple iSCSI Initiator Names

The Microsoft iSCSI Software Initiator may sometimes use an iSCSI initiator name other than the one set in its configuration.

For example, if the configured initiator name ends with the fully qualified domain name of the host, when making iSCSI connections, the iSCSI Software Initiator may use a name ending with only the node name of the host. In this case, the Pillar Axiom Storage Services Manager and command line interface (CLI) will report that the host is using two iSCSI initiator names, both the configured name and the name it is actually using.

This is normal behavior of the Microsoft iSCSI Software Initiator. In this case, the iSCSI Software Initiator effectively has two names associated with it, and APM is reporting both of these names.

[13750786] Warmstart Suspends I/O to LUNs

If a Pillar Axiom system experiences a temporary outage on one Slammer control unit (CU) while attached to a Windows host running Pillar Axiom Path Manager (APM), the LUNs on the non-failing CU may experience a suspension of I/O for a period longer than the normal recovery process. All I/O should resume without failure, however, after this brief delay.

[13754533] Hyper-V Delays Switching to Alternate iSCSI Path

Windows Server with Hyper-V enabled can take an exceptionally long time to report iSCSI path failures to Pillar Axiom Path Manager (APM), resulting in long delays before APM moves I/O to an alternate path.

For example, I/O may pause for five minutes or more before it is transferred from one Slammer control unit (CU) to its alternate CU. This issue can occur on the Hyper-V host or on operating system instances running in guest partitions.

There is no known workaround for this issue.

[13755165] Added iSCSI Paths Not Detected

iSCSI paths added to a formerly Fibre Channel-only host might not be detected by APM.

When LUNs on a Pillar Axiom system are mapped to the SAN host through Fibre Channel, and iSCSI paths are subsequently enabled, APM might not detect the iSCSI paths. When the iSCSI Software Initiator is configured on the host, it will successfully connect to the Pillar Axiom system through iSCSI, but APM will not detect the iSCSI paths.

Reboot the host to correct the problem.

[15906824] Failed iSCSI Paths Not Detected

If a physical network link is removed while being used by an iSCSI connection, the system may not notice that the iSCSI connection has failed until I/O is sent over the failed link.

APM does not normally send I/O over non-optimized paths so Windows and APM may continue to report that the iSCSI non-optimized path is present and working although the underlying physical network link has failed.

[16022428 16050171] QLogic iSCSI Driver Crashes

Windows may halt unexpectedly with a blue screen when establishing connections through the QLogic iSCSI driver or when connections through the QLogic iSCSI driver fail.

This problem has been observed with both iSCSI CNAs and HBAs and has been reported to QLogic. A solution to this problem was being developed by QLogic at the time this document was published. We recommend that you install the most current iSCSI driver available from QLogic.

[16049073] Qlogic iSCSI SAN HBA

When booting from an iSCSI SAN through a QLogic HBA, the iSCSI sessions created by the HBA firmware during the boot process are not always subsequently made available to Windows.

This means that some of the iSCSI connections between the HBAs and the Axiom Slammers cannot be used as paths by MPIO and will not be counted by APM.

Microsoft Windows Knowledge Base MPIO Articles

Pillar Axiom Path Manager (APM) uses the Windows Multipath I/O (MPIO) feature. Unless your system already has some other MPIO-based multipathing solution installed, the installation of APM will install and enable MPIO. It is therefore possible that issues caused by this Microsoft multipathing feature may become apparent on your system after installing APM. The following table lists current entries in the Microsoft Windows Knowledge Base describing issues that may apply when Microsoft MPIO is implemented on your system.

Table 11 Microsoft Windows MPIO knowledge base articles

Article ID	Summary
977506	The iSCSI Software Initiator Setup program does not select the default options as expected.
977567	An upgrade from Windows Server 2008 SP1 to Windows Server 2008 R2 rolls back if the default SAN policy is set to "offline shared"
978562	The "Validate Multiple Arbitration" test on a Windows Server 2008 R2-based failover cluster may incorrectly fail.
940393	Event ID 271 is logged in the System log after you install Microsoft MPIO Multipathing Support for iSCSI on a computer that is running Microsoft Windows Server 2003 or Microsoft Windows 2000 Server.

Table 11 Microsoft Windows MPIO knowledge base articles (continued)

Article ID	Summary
947788	The System Recovery Tool in System Center Data Protection Manager 2007 cannot create recovery points when the protected server is a passive node of a cluster or when the protected server has multipath I/O disks.
951434	The Windows Server 2008 cluster validation process may fail when disjoint iSCSI networks use the same subnet.
951590	Multipath I/O disks may disappear after you use the Hot Add Processor feature to add a new CPU to a Windows Server 2008-based computer.
952775	Error message after you uninstall MPIO on a Windows Server 2003-based computer that has the iSCSI boot sequence enabled: "STOP: 0x0000007B".
952779	A Windows Server 2008-based computer that has a single-processor stops responding if an MPIO-connected device is repeatedly connected and then disconnected.
953531	A "0x0000007E" Stop error occurs in Windows Server 2008 after you unmount and delete a persistent VSS snapshot.
953652	A physical disk resource may unexpectedly fail or go offline when the IsAlive function is executed on a Windows Server 2008 cluster node.
957509	Stop error when you use a Microsoft Device Specific Module in Windows Server 2008: "0x000000C2".
957522	The Windows Server 2008 system may stop responding when an error occurs on one of the logical units of a storage array that is connected over a single MPIO path.
958912	A Windows Server 2008-based computer may stop responding when you use a Device Specific Module that plugs into MPIO.
961570	The system becomes unresponsive after the primary MPIO path is disconnected on a Windows Server 2008-based computer.
961891	Error message when you try to restart or shut down a Windows Server 2008-based computer that is connected to an MPIO-controlled storage device: "Stop 0x0000009F".

Table 11 Microsoft Windows MPIO knowledge base articles (continued)

Article ID	Summary
963702	A Windows Server 2008 Failover Cluster that has a MPIO solution may encounter stop code 0x0000007E or 0x000000D5 during a path failover.
967349	Access to an MPIO-controlled storage device fails on a Windows Server 2008-based computer after you disconnect and then reconnect all data cables.
967724	A Windows Server 2008-based computer that has the MPIO solution installed and that has many LUNs attached stops responding during the startup process after you install hotfix 963702.
967999	A Stop 0x0000007E error may occur when you start a Windows Server 2008-based computer from an iSCSI boot device that is connected over MPIO paths.
968287	The MPIO failover process does not complete on a Windows Server 2008-based computer that uses Microsoft Device Specific Module for MPIO.
969255	A D1 Stop error may occur when you use Microsoft Multipath I/O (MPIO) together with multiple host bus adapters on a Windows Server 2003-based computer.
970525	Cluster resources fail over before the time expires in the PDORemovePeriod parameter in Windows Server 2008.
972324	Support for an adjustable PathRecoveryInterval in Windows Server 2008.
973607	When MPIO disks are enumerated under stress, ports may be missing from Device Manager Location field.
973663	After you generate an MPIO configuration report on a computer that is running Windows Server 2008 R2, some the text in the report is not readable.
974878	PhysicalDisk counters contain invalid and duplicate entries when you use MPIO to control one or more storage devices.
977506	The iSCSI Software Initiator Setup program does not select the default options as expected.

Table 11 Microsoft Windows MPIO knowledge base articles (continued)

Article ID	Summary
977567	An upgrade from Windows Server 2008 SP1 to Windows Server 2008 R2 rolls back if the default SAN policy is set to offline shared.
978562	The Validate Multiple Arbitration test on a Windows Server 2008 R2-based failover cluster may incorrectly fail.

Resolved APM Issues

The issues listed in the following table have been resolved in the current release of Pillar Axiom Path Manager (APM).

Table 12 Resolved APM issues

Issue
[13753394] Windows sometimes halts unexpectedly with a blue screen at the end of an APM installation or during reboot after an APM installation.
[13756487] Callhome log sometimes incorrectly truncated.
[14005797] Installation failed on systems where third-party disk management programs had left invalid entries in the Windows Registry.

Additional Notes

[48764, 48811] Faulty SAN Component

Faulty SAN hardware components can cause unreliable data transfer, resulting in a variety of different symptoms in Windows.

For example, some tests were performed using an iSCSI SAN running over Ethernet with Jumbo Frames enabled. The Ethernet chipset on the host did not correctly support Jumbo Frames (the details of its behavior are not known). The symptoms included:

- A LUN appeared to be accessible and usable until a `chkdsk` command was run. Part way through execution of the command, all paths failed in sequence and the LUN was taken off-line.
- `iscsicli` commands and the iSCSI management applet sometimes hang.
- Small LUNs worked correctly but large GPT LUNs had access errors.
- Cluster nodes would fail over after apparently random access errors.

Index

A

additional notes *73*

APM

features *21*

function *16*

how to

download software *46*

install software *47*

remove software *59*

update software *57*

in a cluster environment *27*

interaction with Pillar Axiom *17*

pre-installation requirements *40*

APM software

control path *19*

data path *20*

known issues *62*

operating limits *28*

B

boot-from-SAN

boot device failover *53*

boot device paths *52*

boot LUNs *52*

clone boot LUN *53*

supported configurations *25*

Brocade *33*

C

Cisco MDS switch

configure *43*

cluster environment *27*

CNA drivers

recommended settings *33*

CNAs

FCoE *33*

contact information *10*

contacts, Oracle *11*

control path *19*

conventions

typographical *9*

customer support *10*

D

Device Specific Module

See DSM

documentation *10*

feedback *10*

download

APM software *46*

DSM

function *16*

how to

install software *47*

E

education programs *10*

Emulex *30, 33*

recommended HBA settings *31*

F

Fabric Interconnect *35*

FC

iSCSI-to-FC routers *37*

FCoE

supported CNA settings *33*

supported CNAs *33*

supported switches *34*

features *21*

new in this release *61*

feedback, documentation *10*

Fibre Channel

supported HBA settings *30*

supported HBAs *29*

supported SAN components *29*

supported switches *31*

Xsigo emulation over InfiniBand *35*

H

HBA drivers

pre-installation requirements *41*

recommended settings *30*

supported Fibre Channel *29*

supported iSCSI *37*

HBAs

- Fibre Channel *29, 42*
- iSCSI *37*
- hotfixes
 - pre-installation requirements *41*
- Hyper-V *26*
- I**
- initiator
 - iSCSI *36*
- install
 - APM software *47*
 - DSM *47*
 - MPIO *47*
- iSCSI
 - how to
 - configure Cisco MDS switch *43*
 - configure iSCSI-to-FC router *43*
 - supported HBAs *37*
 - supported initiator *36*
 - supported routers *37*
 - supported SAN components *36*
 - supported switches *38*
- iSCSI software
 - pre-installation requirements *41*
- iSCSI-to-FC router
 - configure *43*
- issues
 - additional notes *73*
 - APM software *62*
 - MPIO *68*
 - operating system *66*
 - Pillar Axiom system *63*
 - resolved *72*
- K**
- knowledge base
 - Microsoft *68*
- L**
- load balancing
 - round-robin *54*
 - static *54*
- LUN access
 - multi-protocol *55*
 - precedence *55*
 - preferred paths *55*
- LUN configuration
 - SAN hosts *49*
- M**
- management network
 - pre-installation requirements *40*
- Microsoft knowledge base *68*

- MPIO
 - function *16*
 - how to
 - install software *47*
 - remove software *59*
 - known issues *68*
- multi-protocol access
 - definition *55*
 - precedence *55*
 - preferred paths *55*
- Multipath I/O
 - See MPIO
- N**
- new features *61*
- non-optimized path *55*
- O**
- online help *10*
- operating system
 - known issues *66*
- optimized path *55*
- Oracle Documentation *10*
- Oracle Fabric Interconnect *35*
- Oracle Fabric Interconnect drivers *35*
- Oracle Technology Network *10*
- P**
- Pillar Axiom
 - interaction with APM *17*
- Pillar Axiom system
 - known issues *63*
- pre-installation requirements *40*
 - HBA drivers *41*
 - hotfixes *41*
 - iSCSI software *41*
 - management network *40*
 - service packs *41*
- product support *10*
- Q**
- Qlogic *30, 33, 37*
- QLogic
 - recommended HBA settings *31*
- R**
- related documentation *9*
- release notes
 - additional notes *73*
 - APM issues *62*
 - MPIO issues *68*
 - operating system issues *66*
 - Pillar Axiom issues *63*

resolved issues 72
remove
 APM software 59
 MPIO 59
requisite reading 9
resolved issues 72
round-robin load balancing 54
routers
 iSCSI-to-FC 37, 43

S

sales information 11
SAN components
 supported FC 29
 supported iSCSI 36
SAN hosts
 LUN configuration 49
service packs
 pre-installation requirements 41
settings
 cluster timeout 27
static load balancing 54
Support portal 10
supported
 Pillar Axiom models 12
 Windows platforms 13
switches
 Cisco MDS 43
 FCoE 34
 Fibre Channel 31
 iSCSI 38

T

training programs 10
typographical conventions 9

U

uninstall
 APM software 59
 MPIO 59
update
 APM software 57

V

Virtual Hard Disk 26

W

Windows 2008
 Hyper-V support 26
Windows 2012 26

X

Xsigo drivers 35